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(71) Applicant *(for all designated States except US)*: THE WHITAKER CORPORATION [US/US]; Suite 450, 4550 New Linden Hill Road, Wilmington, DE 19808 (US).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: LINDEBERG, Paul [SE/FR]; 23, rue de Puebla, F-78600 Maisons-Laffitte (FR). PICAUD, Jean-Pierre [FR/FR]; 44, rue Edouard-Vaillant, F-95600 Eaubonne (FR).

(74) Agents: NINA, Driscoll, A. et al.; AMP International Enterprises Ltd., AMPèrestrasse 3, CH-9323 Steinach (CH).

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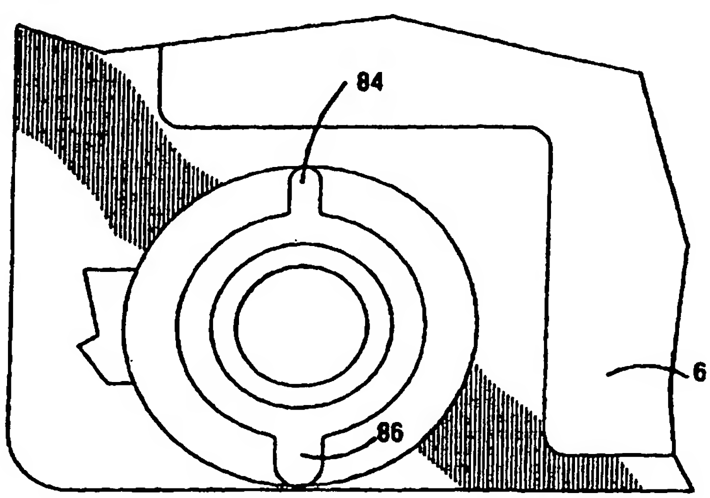

(57) Abstract

A battery terminal (2) comprises a threaded actuator (8), a stamped and formed contact section (14), and a plate-like spring member (10). The actuator (8) threadably engages tabs (32, 34) of the contact section thereby flattening the plate-like spring (10) to cause radial inward compression of the spring against the contact section. Axial insertion of the battery terminal over the battery post, and subsequent rotation of the actuator is easily effected by automated assembly means. Furthermore, manual coupling and uncoupling is easy due to the significant force reduction of the spring lever arm effect and rotation of the actuator. The resiliency of the spring enables a large absorption of dimensional tolerances and thermal expansion for reliable contact.

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AUTOMOTIVE BATTERY TERMINAL

This invention relates to a terminal for connection to an automotive battery.

There are a great number of different designs available for automotive battery terminals, from simple terminals that comprise a conically shaped through hole and that are clamped to the battery terminal by bolt means, to quick release terminals with lever arms that are clamped to the battery terminal in a tool-less manner. Despite the large number of designs available, automotive manufacturers often opt for very simple designs which are mounted to a battery post by clamping with a bolt. One of the problems with available tool-less designs, is either they are complex, difficult to manufacture and costly, and/or they lack the requisite clamping force and reliability. Due to the large currents that transit from the battery to the automobile, a significant contact force is required by the battery terminal on the post. It is a problem to combine both the requisite clamping force, the required robustness and reliability of the terminal, in a cost-effective manufacturable form that is needed in the automotive industry.

One of the problems with the simple bolt clamped battery terminal, is that the assembly of the battery terminal to the battery post requires tools, the clamping force is not well defined and may be unreliably effected by an operator (for example the bolts not sufficiently tightened), and manual assembly is required.

It would be desirable on the one hand to increase the ease of mounting of a battery terminal (and release) to a battery post, whilst increasing the reliability of the contact, and ensuring the requisite contact forces are provided in a cost-effective form. It would be particularly advantageous to provide such a terminal in a form that enables automated assembly.

It is an object of this invention is to provide a battery terminal that enables easy assembly and

disassembly from a battery post, yet provides high contact force in a reliable manner.

It would be advantageous to provide a battery terminal that can be coupled to a battery post in an automated manner.

It would be advantageous to provide a battery terminal that is easy to assemble and disassemble from a battery post, yet provides the requisite contact force and is nevertheless cost-effective to manufacture.

Objects of this invention have been achieved by providing the battery terminal according to claim 1. Advantageously, the battery terminal is easy to mount and the axial movement of the actuator is effected easily by automated means. Furthermore a large lever-arm effect is transmissible by axial movement of the spring being transferred into radial compression, thereby leading to high contact force, but low actuation force. The resiliency provided by the spring ensures ability to absorb dimensional tolerances, or thermal displacement, for a reliable contact. The coupling can be made either by a screw action of the actuator without requiring tools, and which could be effected by an automated robot means due to the vertical access thereto, or by merely depressing, in an axial direction, on the actuator or terminal as a whole. Manual and tool-less disassembly is also enabled in a simple manner. The decoupling of forces between the threaded actuator, or push button mechanism ensures provision of a very high contact force whilst requiring low forces by an operator or a robot on the actuation member. The contact portion of the battery terminal can be integrally stamped and formed with a connection portion of the battery terminal, wherein the few number of parts (spring, actuator and terminal) are relatively cost-effective to manufacture and assemble.

Further advantageous aspects of this invention are described in the claims or will be apparent from the following description and drawings.

Embodiments of this invention will now be described,

by way of example, with reference to the figures, whereby;

Figure 1 is a cross-sectional view through part of a battery terminal according to this invention, positioned uncoupled on a battery post;

Figure 2 is a view in the direction of arrow 2 of Figure 1;

Figure 3 is a view similar to that of Figure 1, but with the battery terminal fully coupled to the battery post;

Figure 4 is a view in the direction of arrow 4 of Figure 3;

Figure 5 is a top view of the contact section of the terminal of Figure 1;

Figure 6 is a view in the direction of arrow 6 of Figure 5;

Figure 7 is a top view of a spring of the terminal of Figure 1;

Figure 8 is a cross-sectional view through an actuation member of the terminal of Figure 1;

Figure 9 is a view in the direction of arrow 9 of Figure 8;

Figure 10 is a cross-sectional view of another embodiment according to this invention mounted to a battery post and positioned in an uncoupled state;

Figure 11 is a cross-sectional view of the terminal of Figure 10 in the fully coupled position;

Figure 12 is a top view of a spring member of the embodiment of Figure 10;

Figure 13 is a cross-sectional view through the contact section of the terminal of Figure 10;

Figure 14 is a cross-sectional view of a third embodiment according to this invention mounted to a battery post in an uncoupled state; and

Figure 15 is a cross-sectional view of the terminal of Figure 14 showing the terminal in the fully coupled state.

Referring first to Figures 1 and 2, a battery

terminal 2 for mounting to a battery post 4 of an automotive battery 6 comprises an actuator 8, a spring member 10, and a contact member 12.

Referring to Figures 5 and 6, the contact member 12 is stamped and formed from sheet metal, and comprises a contact section 14 integrally connected to a base section 16 that is only shown partially, and which extends to a connection section for interconnection to power supply cables of an automobile. The contact section 14 comprises a substantially conical contact wall 18 forming a conical battery post receiving area or cavity 20, the wall 18 being separated by a gap 82 at a side opposite the base wall extension 18. The outer wall 18 extends from a top end 24, to a lower end 26, the bottom end 26 being at the larger section of the cone. The outer wall 18 comprises beams 28 that extend and are attached proximate the top end 24, to the bottom end 26, whereby a slot 30 separates the adjacent beams 28 from proximate the top end 24 to the bottom end 26. The contact section 14 further comprises tab extensions 32,34 extending from and above the top end 24, and outwardly bent to free ends 36,38 that project in a radial direction with respect to the axis 40 of the cone. The free ends 36,38 of the different tabs 32 are positioned at different heights that correspond to their position in a spiral, such that the tabs simulate a spiral thread for screw engagement with the actuator. The tabs 31,32,33,34 are spaced at irregular intervals around the wall 18 in order to polarize the contact section 12 with respect to the actuator during assembly (i.e. only one orientation of the actuator with respect to the contact section 14 is allowed).

Referring to Figures 8 and 9, the actuator 8 comprises a housing 42 having a cavity 44 extending therethrough from a top end 46 to a bottom end 48, the cavity for receiving the contact section 14 therein. The cavity 44 is formed by a wall 50 of the housing. A spiraled recess or thread 52 is provided in the wall 50 for screw engagement with the contact section tabs 31-34.

The wall 50 is further provided with axial grooves 54 extending in the axial direction (i.e. in the direction of the axis 40) and are arranged around the inner periphery of the cavity 40 for receiving the tabs 31-33, the grooves 54 enabling the actuator to be positioned over the contact section 14 until the tabs align with the first thread 56 of the spiral thread 52 for engagement therewith. The actuator further comprises a larger diameter spring receiving cavity 58 proximate the bottom end 48 of the actuator.

Referring to Figure 7, the spring member 10 comprises a largely planar spring stamped and formed from sheet metal in an integral piece, and comprising a base 60 having a central cutout 62 for receiving the contact section 14 therein, the cutout 42 bounded by cantilevered spring beams 64 having their free ends 66 forming an edge of the cutout 62, and their attached ends 68 proximate the outer periphery 70 of the base 60. The free end 66 is provided with protrusions 72 at either corner that engage either side 74 (see Figure 5) of the contact section beams 28, the side 74 being recessed with respect to a lower portion 76 such that a shoulder 78 is formed thereon. The shoulder 78 engages the spring protrusions 72 thereby axially retaining the spring to the contact section. The spring beams 64 are interconnected around the periphery by bridging portions 80 that have a V-shape, the apex of the V being directed towards the cutout area 62. The V-shape of the bridging portions 80 enable the spring beam free ends 66 to bias in the axial direction with large displacements, whereby the bridging portion is able to bias in the same direction (allowing a substantially conical shape to be formed) and providing some flexibility in contraction and expansion of the diameter of the periphery 70 due to their radially inwardly bent shape.

Referring to Figures 1-4, connection of the terminal 2 to the battery post 4 will now be explained. Initially, the contact section 14 is inserted over the battery post 4. The actuator 8 which is preassembled with the spring

10, in it's natural state, has the spring beams 64 inclined obliquely downwardly as shown in Figure 1. The actuator 8 and spring 10 can subsequently be inserted over the contact section 14, whereby the tabs 31-34 are inserted through the grooves 54 (see Figure 9) of the actuator housing that ensures correct polarization of the actuator with respect to the contact section. The grooves 47 extend up to the lowest thread groove 56. When the tabs 31-34 enter into the lower thread groove 56, the spring beams 64, and in particular the protrusions 72 (see Figure 7) abut the shoulders 78 of the contact section to provide the assembly arranged as shown in Figure 1. The actuator 8 can then be rotated, whereby engagement of the tabs 31-34 in the threaded groove causes the actuator to descend axially and flatten the spring 10 as shown in Figure 3. The flattening of the spring causes inward radial pressure of the spring beams 64 against the contact section beams 28, whereby the spring V-shaped portions 80 tend to straighten out a little such that the outer diameter of the spring can expand slightly in a resilient manner, the resiliency providing the spring force.

A large spring force can thus be applied with minimal actuation forces due to the lever arm effect of the actuator biasing the spring on its outer periphery, in addition to the small displacement in the axial direction, but large rotational displacement of the actuator due to the threaded groove. The actuator 8 may be provided with outer radial protrusions 84,86 in order to apply the torque, whereby the protrusions 84,85 may have a slightly different shape or thickness to ensure that an automated robot means holds the actuator in the correct orientation. Due to the ability to assemble the contact section over the battery post in the axial direction, as well as inserting the actuator axially over the contact section, fully automated assembly of the battery terminal and coupling is easily effected. Furthermore, due to the large lever arm effects of the screw thread and actuator on the spring beam, manual coupling and uncoupling is easy to

effect. A further advantage is the great flexibility and the elastic energy stored in the spring member 10 that absorbs thermal expansion, and mechanical tolerances, to ensure sufficient contact pressure over a large range of tolerances and operating conditions.

It would also be possible to assemble the terminal 2 to the battery post 4 by preassembling the actuator 8, spring 10 and contact section 14 together, and rotating the actuator to the fully coupled position, as shown in Figure 3, prior to assembly to the battery post 4. Subsequently, an automated robot means would simply apply axial pressure to mount the assembled battery terminal to the battery post. Uncoupling of the battery terminal can be done manually by merely unscrewing the actuator. Small dimples or latches can be provided in the actuator grooves 54 to retain the tabs 31-34 in the lower thread 56 once preassembled thereto, such that an operator can lift the battery terminal off the battery post 4 by pulling up on the actuator.

Referring to Figures 10-13, another embodiment of this invention will now be described. A battery terminal 2′ comprises an actuator 8′, a contact member 12′, and a spring 10′. The contact member 12′ comprises a contact section 14′ having an outer wall 18′ forming a conical cavity 30′ therein for receiving the battery post 4. The outer wall 18′ comprises a plurality of beams 28′ attached proximate an upper end 24′ and extending to free ends at a lower end 26′ of the outer wall. The outer wall 18 comprises protrusions 78′ extending radially outwards and forming a groove 79′ for receiving and axially retaining the spring member 10′. The actuator 8′ comprises a threaded groove 32′ for engaging the periphery 70′ of the spring member 10′. The spring member 10′ comprises a base 60′ stamped and formed from sheet metal, comprising a plurality of cantilever spring beams 64′ attached proximate the periphery 70′ and extending radially inwards to free ends 66′ that substantially define a central cutout area 62′ for receiving the contact section 14′

therein. Spring beams 64' are interconnected by inwardly curved bridging portions 80' that enable resilient expansion and contraction of the diameter of the periphery 70' in a similar manner to that already described for the spring member 10 of Figure 7.

The terminal 2' is assembled to the battery post as follows. Initially, the actuator 8', spring 10' and contact section 14' are assembled together such that the spring is engaged in the threaded groove 52', and the spring beams 64' engaged at their free ends 66' in the contact section slot 79'. In the preassembly position, the actuator threadably engages the spring outer periphery 70' which is received in an upper portion of the actuator such that the spring beams 64' are downwardly inclined with respect to a horizontal plane as shown in Figure 10. In this preassembly position, the assembled terminal 2' can be axially mounted on the battery post 4 by simply inserting it thereover. The actuator 8' is then rotated such that the outer periphery 70' is threaded into the lower portion of the actuator, the spring member thus being flattened, causing the spring beams 64' to exert inward radial force on the terminal section. As in the previous embodiment, the large travel of the actuator with respect to the spring causes a significant decoupling of forces that enables easy manual coupling or uncoupling of the battery terminal. Automated assembly is also facilitated by the low torque required to turn the actuator, and the axial insertion of the terminal over the battery post. The axial insertion and rotational movement of the actuator by a robotic arm is well adapted for automated assembly. Furthermore, the advantages of a flexible resilient contact pressure for the absorption of tolerances and thermal displacements, is as already described above. In the embodiment of Figures 10 and 11, the actuator 8' is retained axially with respect to the contact section 14', for example by providing the contact section with tabs extending above the top end 24' that engage in a groove in the actuator (not shown).

Another embodiment of a terminal 2'' according to this invention is shown in Figures 14 and 15. The terminal 2'' comprises an actuator 8'', and a contact member and spring member 12',10' that could be identical to the contact and spring members described in the embodiments of Figures 13 and 12 respectively. The actuator 8'' comprises a base wall 9'' that is axially fixed by latch means 11'' to the contact section outer wall 18'. A push button 13'' is attached via resilient bridging sections 15'' to the base member 9''. The push button 13'' has a groove 58'' for axially receiving and retaining the outer periphery 70' of the spring member 10' therein proximate a lower end 48'' of the actuator. In the precoupled state, the spring beam 64' of the spring member 10' are obliquely positioned (the spring member has a substantially conical shape in this configuration), and the push button 13'' is in the upper position. The actuator bridging portions 15'' are resilient thin walls that provide some axial resilient force maintaining the push button 13'' in the upper position. The terminal 2'' is assembled to the battery post 4 by insertion of the contact section 14 over the battery post, whereby the axial resiliency of the bridging sections 15'' and the spring member 10' on the push button 13'' ensures that a good seat of the contact section on the battery post is effected prior to full coupling.

The axial depression of the push button 13'' flattens the spring member 10' until it buckles over to a slightly oblique position in the opposed direction to the precoupled state as shown in Figure 15, to ensure that the push button remains in the fully coupled state. As the spring 10' is flattened more in the fully coupled state as shown in Figure 15, than in the precoupled state as shown in Figure 14, inward radial compression on the contact section is provided in a similar manner to that already described for the previous embodiments.

In the embodiments of Figures 14 and 15, the terminal is particularly simple to assemble and therefore advantageous for automated assembly, but also for manual

coupling and uncoupling. Axial displacement of the push button 13'', in comparison to the inward radial biasing of the spring is large, therefore providing a great lever arm effect.

CLAIMS

1. A battery terminal (2,2′,2′′) for connection to a post (4) extending along an axial axis (40), comprising a contact section (14,14′) having a wall (18,18′) forming a cavity (20) for receiving the post therein in an axial direction, and an actuator (8,8′,8′′) for coupling the contact section to the post, characterized in that the terminal further comprises a spring member (10,10′) disposed around the contact section and having spring beams (64,64′) extending between the contact section and actuator and movable from a first uncoupled position to a coupled position by axial movement of the actuator, such that the spring beams compress resiliently radially inwards towards the axis (40), thereby compressing the contact section against the post.

2. The terminal of claim 1 wherein the spring member is a plate-like integral element.

3. The terminal of claim 2 wherein the spring member spring beams (64,64′) extend radially from an attached end proximate an outer periphery (70,70′) of the spring member, to a free end (66,66′).

4. The terminal of claim 3 wherein the spring beam free ends (66,66′) define an inner cutout area (62,62′) for receiving the contact section (14,14′) therein.

5. The terminal of claims 3 or 4 wherein the spring beams are attached together proximate the periphery (70,70′) by bridging portions (80,80′) that extend through a bend directed radially inwards, to increase the flexibility of the spring member in radial expansion or contraction.

6. The terminal of any one of claims 2-5 wherein the spring member is stamped and formed from sheet metal.

7. The terminal of claim 2 wherein the plate-like spring member has a substantially conical shape in the uncoupled position, and has a flatter shape in the coupled position such that an inner cutout area (62,62') of the spring member resiliently and radially inwardly biases towards the axial axis (40).

8. The terminal of any one of the preceding claims wherein the actuator (8') comprises a screw thread (52') for engaging a portion of the spring member (10'), the actuator being rotatable such that the engaged portion of the spring member is axially biased.

9. The terminal of claim 8 wherein the screw thread engages an outer periphery (70') of the spring member (10').

10. The terminal of any one of claims 1-7 wherein the actuator (8) comprises a screw thread for engaging the contact section (4) to drive the actuator in the axial direction.

11. The terminal of claim 10 wherein the spring member is retained axially proximate it's periphery (70), in the actuator.

12. The terminal of either claim 10 or 11 wherein the contact section has tabs (31,32,33,34) extending radially outwards for engaging in the actuator screw thread (52).

13. The terminal of claim 12 wherein the tabs are arranged so as to polarise the actuator with respect to the contact section.

14. The terminal of either claim 12 or 13 wherein the actuato: comprises axially extending grooves (54) for insertion of the tabs into the screw thread during axial mounting of the actuator over the contact section.

15. The terminal of any one of claims 1-7 wherein the actuator (8'') comprise an axially movable push button (13'') that engages and axially displaces the spring member.

16. The terminal of claim 15 wherein the push button is movably retained to a base portion (9'') that is fixed to the contact section (14').

17. The terminal of either claim 15 or 16 wherein in the coupled state the spring member (10') is biased axially past the position of the greatest radial compression, with respect to the uncoupled axial position that is before such position, in order to axially bias and maintain the push button (13'') in the fully coupled position.

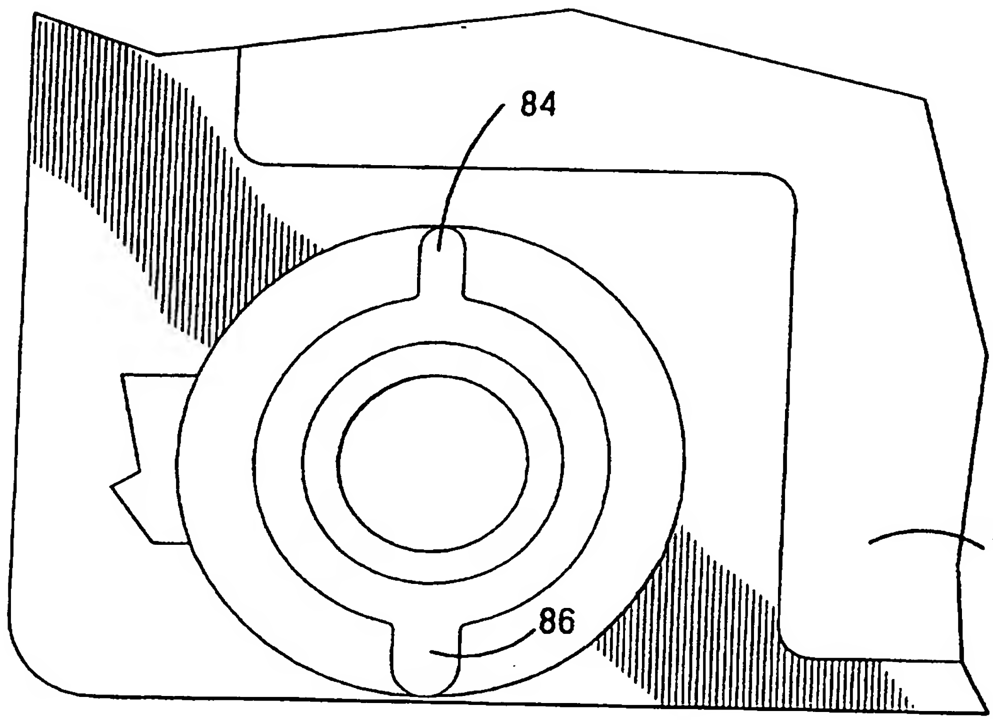

Fig. 2

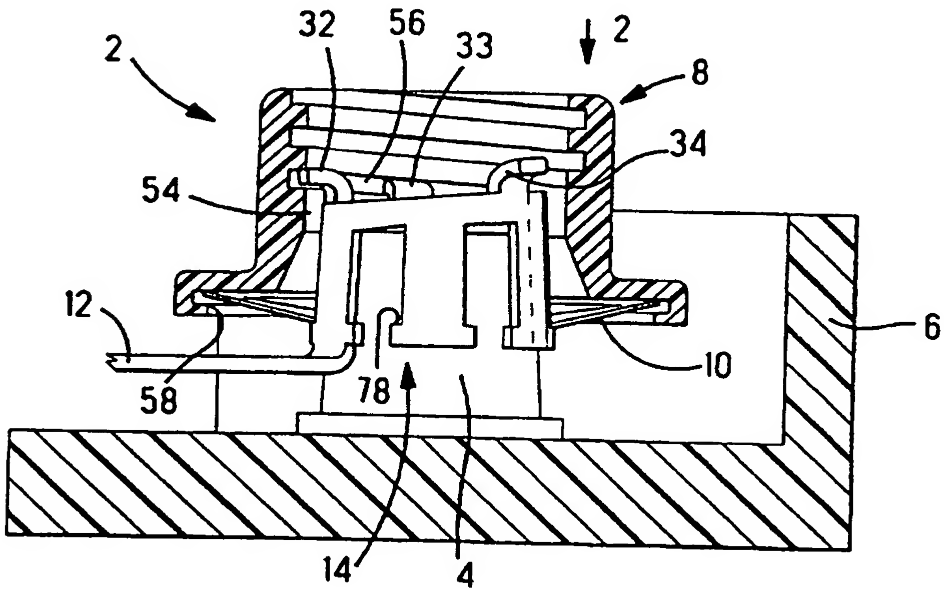

Fig. 1

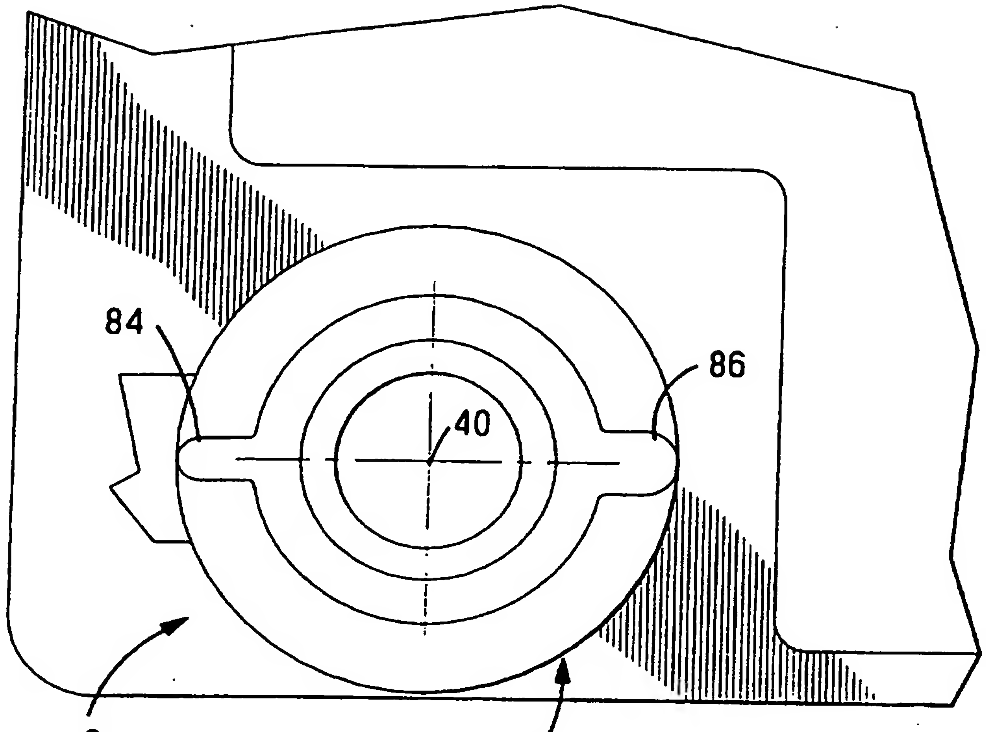

Fig. 4

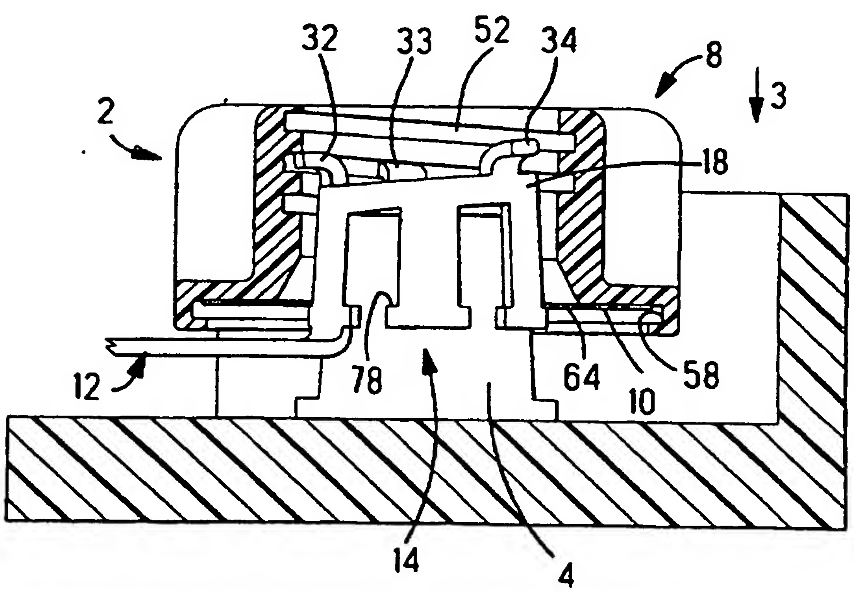

Fig. 3

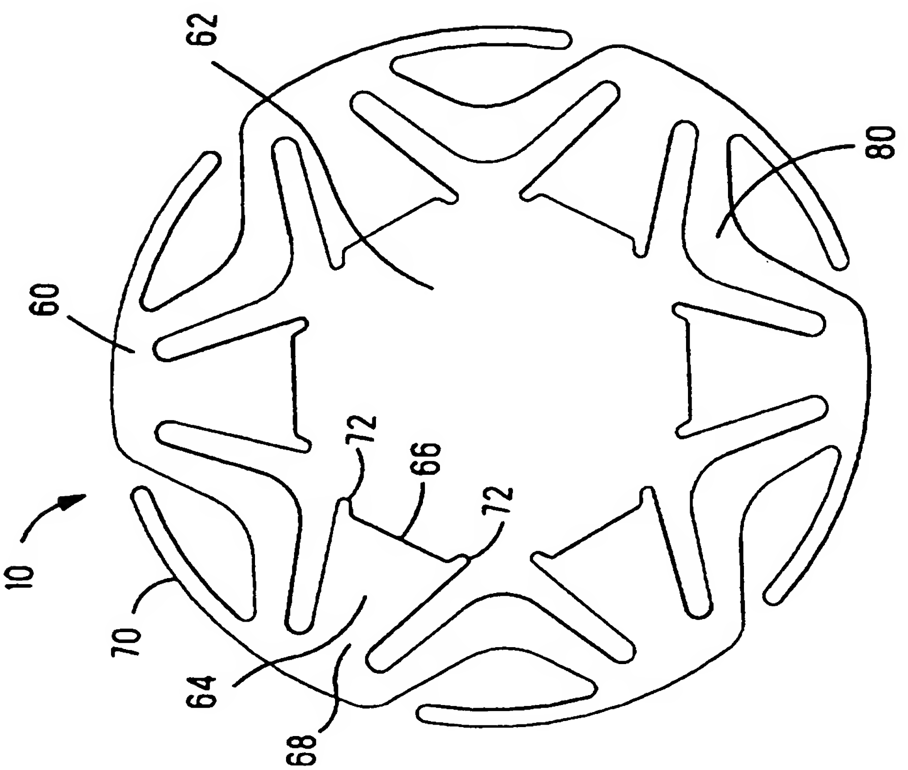

Fig. 7

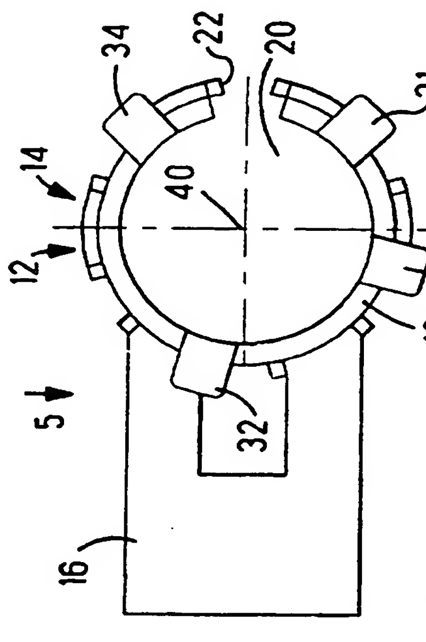

Fig. 6

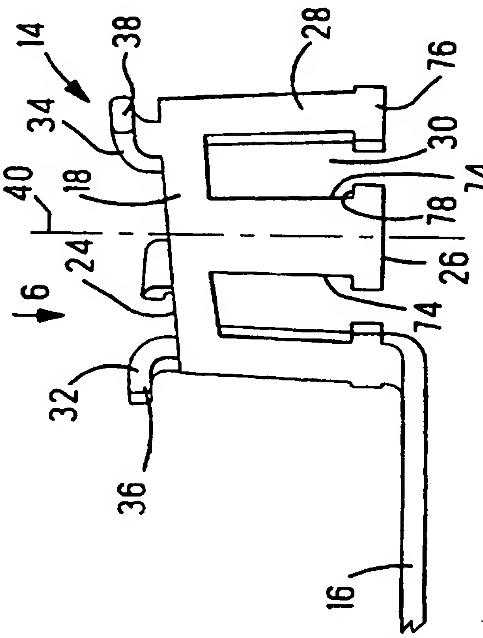

Fig. 5

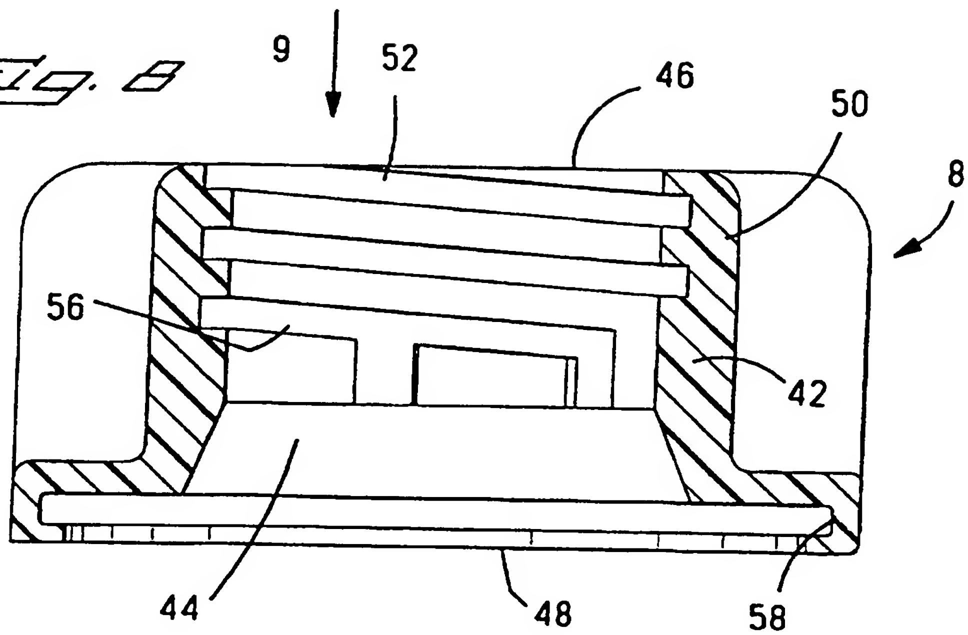

Fig. 8

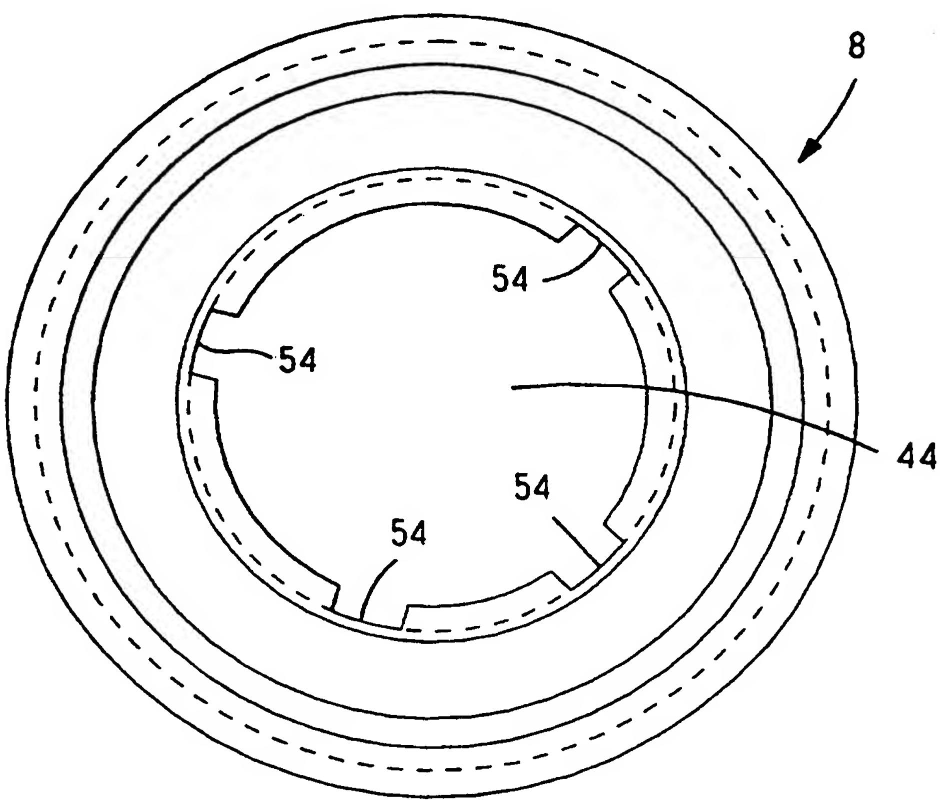

Fig. 9

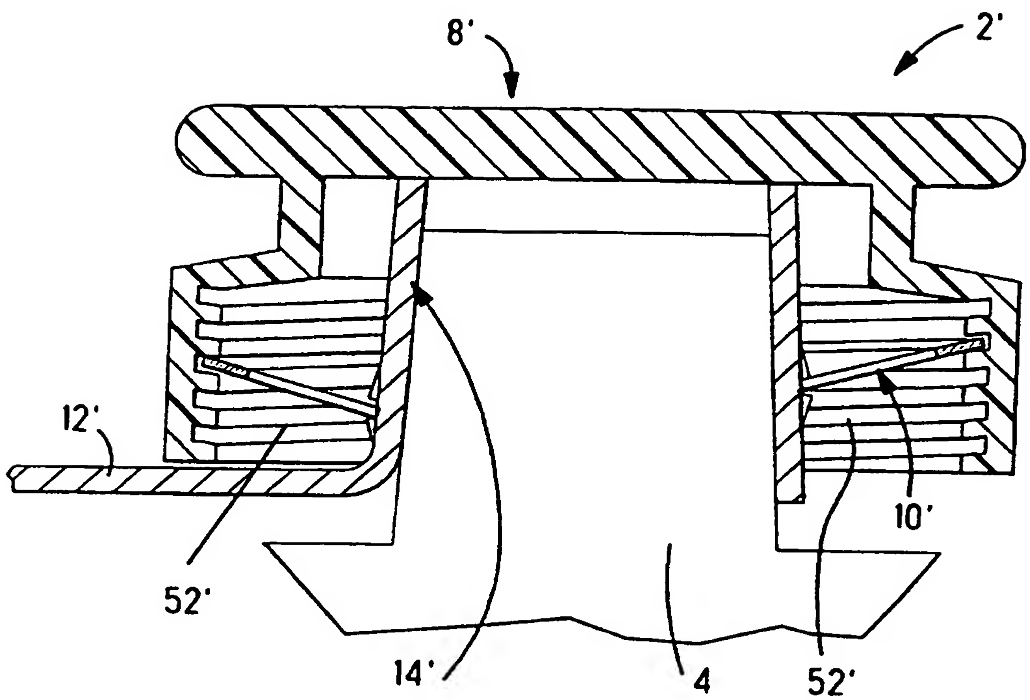

Fig. 10

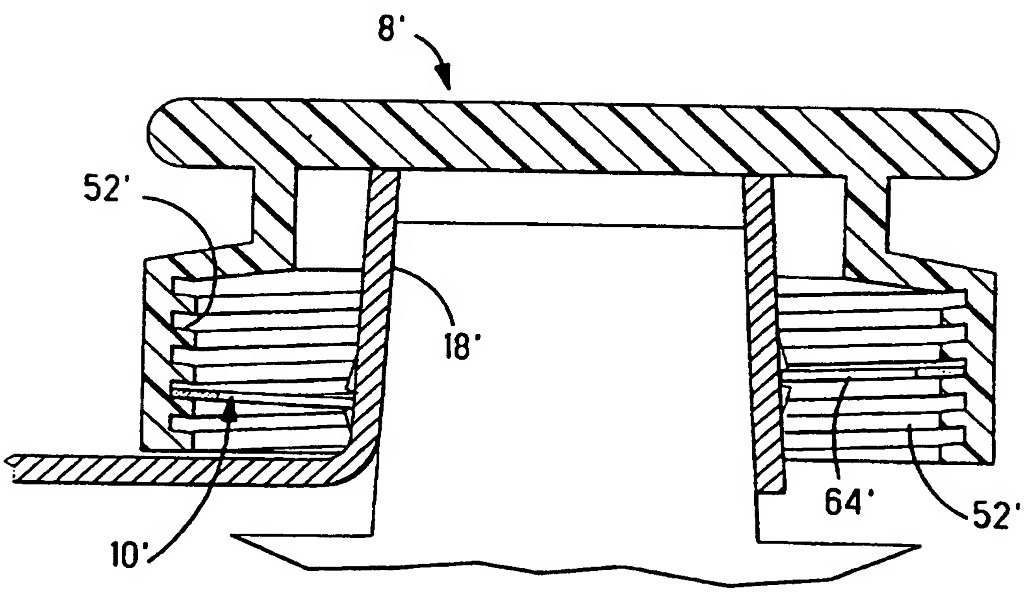

Fig. 11

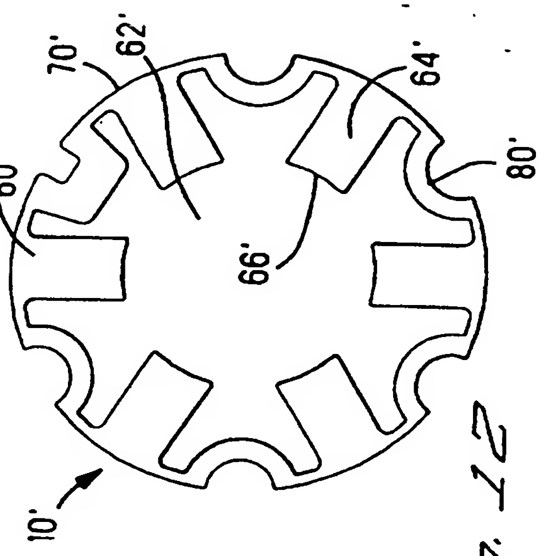

Fig. 12

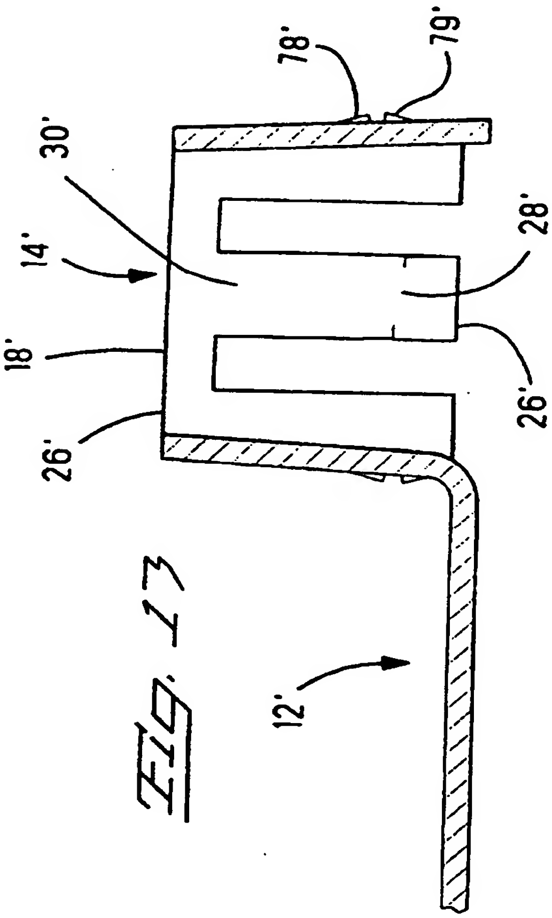

Fig. 13

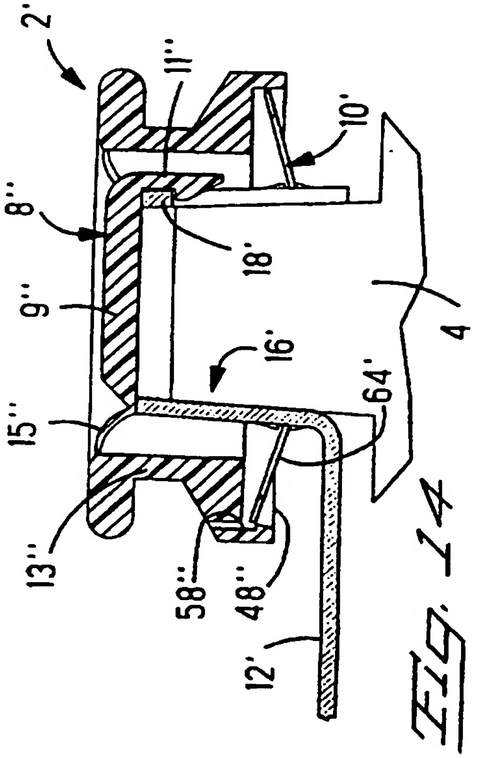

Fig. 14

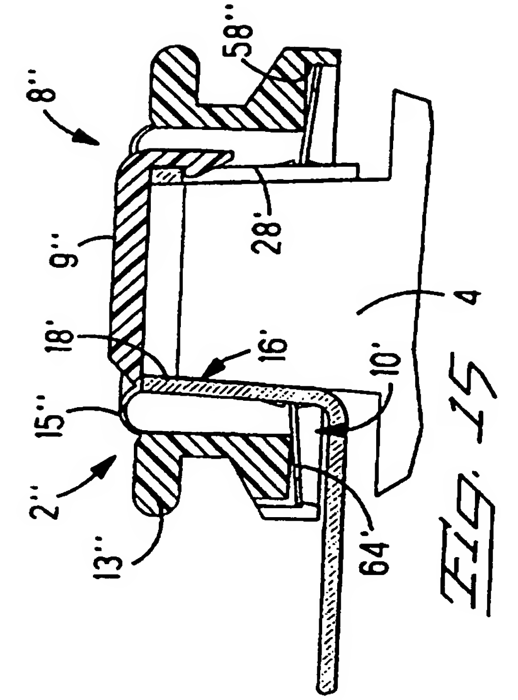

Fig. 15

INTERNATIONAL SEARCH REPORT

International Application No
PCT/IB 97/00272

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H01R11/28 H01M2/30 H01M2/34

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H01R H01M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	FR 2 462 031 A (ERMETO) 6 February 1981 see claims 1-8; figures 1-4 ---	1-17
A	DE 10 74 686 B (F. PORSCHE K.G.) 4 February 1960 see claims 1-4; figure 1 ---	1-17
A	FR 2 601 515 A (PRONER SA ETS) 15 January 1988 see claims 1-10; figures 1-4 ---	1-17
A	EP 0 466 528 A (PEUGEOT ;CITROEN SA (FR)) 15 January 1992 see claims 1-18; figure 1 ---	1-17
A	US 4 470 654 A (FRIEDMAN GLENN) 11 September 1984 see claims 1-7; figures 1,2 -----	1-17

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
19 June 1997	03.07.97

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Battistig, M

INTERNATIONAL SEARCH REPORT

Information on patent family members

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